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SPACE GATEWAY SUPPORT (SGS) **SGS-26 33 53.00 99 (April 2006)**

Preparing Activity: SGS-DE **Superseding SGS-16610J (February 2005)**

SGS GUIDE SPECIFICATIONS

References are NOT in Agreement with UMRL dated 01 April 2006

Revised throughout - changes not indicated by CHG tags
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SECTION 26 33 53.00 99

STATIC UNINTERRUPTIBLE POWER SUPPLY
04/06

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NOTE: This guide specification covers the requirements for three-phase continuous duty, on-line, solid state uninterruptible power systems.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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PART 1 GENERAL

1.1 SUMMARY

This specification describes a three-phase continuous duty, on-line, solid state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of the UPS module, one or more battery strings, and other features as described in this specification.

1.2 UPS MODULE DESCRIPTION

1.2.1 UPS Module Components

The UPS module shall consist of the following main components:

a. Rectifier/Charger
b. Static Inverter
c. Bypass
d. Output Isolation Transformer
e. Control Panel
f. Monitor Panel
g. Communication Panel

1.2.2 UPS Module Modes of Operation

The UPS Module shall operate as an on-line, fully automatic system in the following modes:

1.2.2.1 Normal

The critical load shall be continuously supplied by the Inverter. The Rectifier/Charger shall derive power from the commercial AC source and shall supply DC power to the Inverter while simultaneously float-charging the battery.

1.2.2.2 Battery

Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.

1.2.2.3 Recharge

Upon restoration of the AC source, the Rectifier/Charger shall recharge the batteries and simultaneously shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.

1.2.2.4 Bypass

If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually, without operation of the static switch.

1.3 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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CSA C22.2 NO.107.1-M91 (Canadian Standards Association) Commercial and Industrial Power Supplies. Listed Equipment (US and Canada).

IEC 146.4 International Electrotechnical Commission) Methods of specifying performance and test requirements of uninterruptible power systems.

EN 50091-1 (European Standard) Uninterruptible power systems, General and safety requirements for UPS used in restricted access locations.

EN 50091-2 (European Standard) Uninterruptible power systems, Electromagnetic compatibility requirements.

EN 50082-1 (European Standard) Uninterruptible power systems, Electromagnetic compatibility - generic emission standard; Generic standard class: Residential, commercial and light industrial.

MIL-HDBK-217E (Military Handbook) Reliability Prediction Of Electronics Equipment.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.41	(1980) Surge Voltages In Low-Voltage Ac Power Circuits

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60801-2	(1991) Electromagnetic Compatibility For Industrial-Process Measurement And Control Equipment Part 2: Electrostatic Discharge Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA PE 1	(1992) Uninterruptible Power Systems

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	(2004) 47 CFR 15-Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1778	(1994) Standard for Uninterruptible Power Supply

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy, Air Force, and NASA projects.

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The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

The UPS shall be supplied with sufficient documentation, including the following manuals:

SD-08 Manufacturer's Instructions

One copy of the Installation Manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians to install the UPS equipment.

Submit one set plus electronic copy of the following drawings and data sheets:

Receiving and Installation Instructions

UPS One-Line Drawings
Equipment Outline Drawings
Interconnection Drawings
Battery Wiring Diagram
Accessory Wiring Diagrams

SD-10 Operation and Maintenance Data

One copy of the Operation Manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians to understand and operate the UPS equipment. The manual shall describe the UPS in full by including the following major items:

Operating Procedures
Performance Data and Technical Data
General Description
UPS Module Description
Communications Capability
Battery Description
Accessory Description

1.5 PRECONSTRUCTION REQUIREMENTS AND QUALIFICATIONS

Prior to commencement of construction, submit the following to the Engineer of Record for review and approval:

Installation Manual
Receiving and Installation Instructions
UPS One-Line Drawings
Equipment Outline Drawings
Interconnection Drawings
Battery Wiring Diagram
Accessory Wiring Diagrams
Operation Manual

The UPS manufacturer shall have a minimum of ten years experience in the design, manufacture and testing of solid-state UPS which are compliant with NEMA PE 1. A list of installed UPS of the same type as the manufacturer proposes to furnish for this application shall be supplied with the proposal.

The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and the field service organization.

1.6 ENVIRONMENTAL REQUIREMENTS

The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

1.6.1 Operating Temperature

0 degrees C to +40 degrees C (32 degrees F to 104 degrees F) without derating (excluding batteries).

1.6.2 Storage Temperature

-20 degrees C to +70 degrees C (-4 degrees F to 158 degrees F). Prolonged storage above +40 degrees C (104 degrees F) will cause rapid battery self-discharge.

1.6.3 Relative Humidity (Operating and Storage)

95% maximum non-condensing.

1.6.4 Elevation

5000 ft (1500 m) maximum at 40 degrees C without derating.

1.6.5 Acoustical Noise

Noise generated by the UPS under normal operation shall not exceed 65 dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.

1.6.6 EMI Suppression

The UPS shall meet FCC Part 15 for Class A devices.

1.6.7 Electrostatic Discharge (ESD)

The UPS shall meet IEC 60801-2. The UPS shall withstand up to 25 kV without damage and with no disturbance or adverse effect to the critical load.

1.6.8 Efficiency

The typical UPS efficiency shall be 92% at full unity power factor load and nominal input voltage.

If present, an input auto-transformer may reduce the UPS efficiency an additional 1%.

If present, an input isolation transformer may reduce the UPS efficiency an additional 3%.

1.6.9 Input Surge Withstand Capability

The UPS shall be in compliance with ANSI C62.41, Category A & B (6 kV).

1.7 RELIABILITY AND MAINTAINABILITY

1.7.1 Reliability

The calculated UPS module mean-time-between-failure which would result in an unsuccessful emergency transfer to internal bypass and subsequent load loss, shall be no less than 2,250,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C) and assume the availability of bypass input power to the UPS module.

The calculated mean-time-between-failure for the UPS module, which would result in a successful emergency transfer to internal bypass, shall be no less than 62,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C) and assume the availability of bypass input power to the UPS module.

The calculated mean-time-between-failure for any UPS module component, shall be no less than 43,000 hours. This calculated MTBF shall be derived in accordance with MIL-HDBK-217E guidelines (ground benign conditions at 25C).

The UPS module shall feature redundant power supplies. Power to the control power supplies shall originate from the Rectifier/Charger input, Bypass input and UPS module output. In the event one of the power supplies shall fail, the UPS module shall continue to operate in Normal mode without load derating. A failed power supply condition shall be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm shall automatically clear when the failed power supply is replaced.

The UPS module shall feature redundant cooling fans. In the event one of the fans shall fail, the UPS module shall continue to operate in Normal mode without load derating. A failed cooling fan condition shall be enunciated on the monitor panel and available remotely through the RS232 port. A failure alarm shall automatically clear when the failed fan is replaced.

The UPS module shall utilize high-reliability wiring and connectors. The

UPS module shall not feature ribbon cables.

The inverter controls, rectifier/charger controls, bypass controls and monitoring/communication controls in the UPS module shall be contained, in their totality, on a maximum of four control printed circuit boards.

All power cable connections to power transformers and chokes shall be secured with permanent cold weld crimps which require no maintenance or periodic retorquing. These cold weld crimps shall be Underwriters Laboratories recognized components.

1.7.2 Maintainability

Calculated and demonstrated mean-time-to-repair (MTTR) shall not exceed 30 minutes, including time to diagnose the problem and replace the subassembly.

1.8 SAFETY

The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778.

The UPS shall be certified by the Canadian Standards Association in accordance with CSA C 22.2, NO.107.1-M91.

The UPS shall carry the CE mark, indicating the equipment complies with European Community standards EN50091-1 (Safety) and EN50091-2 (Electromagnetic Compliance).

1.9 WARRANTY

1.9.1 UPS Module

The UPS module warranty shall be no less than 24 months after acceptance and must include all costs including repair, parts, labor, travel and living expenses for the manufacturer's service personnel, within the 48 contiguous United States.

1.9.2 Battery

The UPS manufacturer shall warrant their battery cabinets on a prorated basis for ten years to deliver no less than 80% of its rated capacity, provided the prevailing ambient temperature of the battery area does not exceed 25 degrees C (77 degrees F). For external battery systems, the battery manufacturers' warranty shall apply.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Approved Manufacturers

Powerware Corporation

2.2 UPS MODULE STANDARD FEATURES

The UPS module shall consist of the following standard components:

2.2.1 Rectifier/Charger

The Rectifier/Charger shall convert incoming AC power to regulated DC output for supplying the Inverter and for charging the battery. The Rectifier/Charger shall be of a six-pulse, phase-controlled, solid-state design. The modular design of the UPS module shall permit easy removal of the Rectifier/Charger without removal of any other assembly.

2.2.2 Inverter

The Inverter shall feature insulated gate bi-polar transistors (IGBTs) in a three-leg, pulse-width-modulation (PWM) design with a switching speed of 4500 HZ. The Inverter shall also have the following features:

a. The Inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.

b. The modular design of the UPS module shall permit easy removal of each phase of the Inverter and DC electrolytic capacitors without removal of any other assembly.

c. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to Bypass and from Bypass shall be possible with the Inverter logic, without using the emergency bypass control logic or the static switch. During manual transfers to Bypass mode, the Inverter must verify proper Bypass operation before transferring the critical load to the Bypass.

d. The Inverter shall feature protection circuitry which prevents the IGBTs from sourcing current in excess of their published ratings.

2.2.3 Bypass

The Bypass shall serve as an alternate source of power for the critical load when performing maintenance on the UPS module or when a failure prevents operation in Normal mode. The Bypass shall consist of a naturally-commutated static switch, for high-speed transfers, and wrap-around switchgear. The modular design of the UPS module shall permit removal of the static switch without removal of any other assembly. The static switch shall only be necessary for controlling emergency make before break transfers. The Bypass shall feature the following transfer and operational characteristics:

Uninterrupted transfers to Bypass shall be automatically initiated for the following conditions:

a. Output overload period expired.
b. Critical bus voltage out of limits.
c. Over temperature period expired.
d. Total battery discharge.
e. UPS module failure.

Uninterrupted automatic retransfer shall take place whenever the Inverter is capable of assuming the critical load.

Uninterrupted automatic retransfers shall be inhibited for the following conditions:

a. When transfer to Bypass is activated manually or remotely.

b. In the event of multiple transfer-retransfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten minute period. The fourth transfer shall lock the critical load on the Bypass source.

c. UPS module failure.

All transfers and retransfers shall be inhibited for the following conditions:

a. Bypass voltage out of limits (+/-10% of nominal).
b. Bypass frequency out of limits (+/-0.5 Hz; adjustable, factory set).
c. Bypass out of synchronization.
d. Bypass phase rotation/installation error.

The Bypass shall be manually energized with a keyswitch on the control panel. No additional control logic shall be required.

The logic power required to perform an emergency transfer to bypass shall be derived separately from the logic power required to operate the inverter controls.

The control circuitry required to perform an emergency transfer to bypass shall operate independently from the inverter control circuitry.

The Rectifier/Charger input circuit breaker shall have no effect on Bypass operation

2.2.4 Monitoring and Control Components

The following components shall provide monitor and control capability:

a. Micro-controller driven circuitry: Embedded 20 MHZ, 16 bit, single chip controller.

b. Monitor Panel with status indicators

c. Alarm and metering display

d. Building alarm monitoring

e. Input circuit breaker

f. Inverter and bypass contactors

g. RS-232 (EIA/TIA-232) and RS-485 communication ports

2.2.5 Output Isolation Transformer

The UPS module shall contain an output isolation transformer featuring two primaries (an Inverter Delta winding and a Bypass Wye winding) and a single secondary (a Wye winding to the UPS module output terminals). The Wye/Wye transformation of the Bypass through the transformer shall produce a zero degree phase shift. This transformer shall provide isolation between the primaries and secondary and shall qualify the UPS as a separately derived source when in both Normal and Bypass modes.

2.2.6 Battery Contactor

The UPS module shall contain a two pole contactor for disconnecting the battery from the rectifier output and the Inverter input. A contactor enable switch shall be located on the UPS module control panel. With the UPS module in Bypass mode, this contactor shall permit the rectifier, Inverter, DC capacitors and associated control boards to be safely serviced without opening a battery breaker external to the UPS module.

2.2.7 Battery Management System

The UPS module shall contain a battery management system which has the following features:

a. The battery management system shall provide battery time available, or percent remaining, while operating in Normal mode and Battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Once commissioned, the battery time available information shall be accurate within +/- 3%.

b. The battery management system shall automatically analyze the UPS battery during a user defined periodic test cycle (quarterly, monthly, etc.). During the test, the Rectifier/Charger shall not de-energize, but shall share load with the battery. For determining battery time remaining information, the battery shall be tested under the same load for each user defined periodic test. Should the battery be weak or defective, The battery management system shall detect and enunciate the battery failure condition without transferring the critical load to Bypass.

c. The periodic test performed by the battery management system shall not remove more than 10% of the available battery run time from the battery. The periodic test, if performed on a monthly basis, shall not reduce overall battery life.

d. If a utility outage occurs while a test is in progress, the test shall be discontinued and subsequently conducted at the next programmed interval. The occurrence of the periodic test shall be user programmable for day, date and time.

e. The battery management system shall record and display the pass/fail status, battery voltage and health indicator value of the previous thirty (30) periodic tests.

f. The battery management system shall provide battery health information in the form of a health indication value. When the health indication value approaches 0.80, it shall correspond with battery string end of life.

g. The battery management system shall enunciate a user programmable battery time remaining warning when the UPS module is on battery power.

h. The battery management system shall provide an imminent shutdown alarm to signal a low battery condition.

i. The battery management system shall work with either wet cell

batteries or valve-regulated batteries.

2.2.8 Wiring Terminals

The neutral output compression terminal shall be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module shall contain mechanical compression terminals (adequately sized to accommodate 75(C wiring) for securing user wiring to the following locations:

a. Rectifier/Charger input connections(3 phases)
b. Bypass input connections (3 phases)
c. DC link connections for battery cabinets (positive and negative)
d. AC output connections (3 phases and 1 neutral)

2.3 UPS MODULE OPTIONS AND ACCESSORIES

The UPS module shall consist of the following options and accessories:

2.3.1 Input Filter with Power Factor Correction

The input filter shall reduce the harmonic feedback current to less than 10% total harmonic distortion (THD) reflected onto the utility by the rectifier. Additionally, the filter shall improve the input power factor to approximately 0.95. The input filter shall be housed in the UPS module. The UPS module shall be programmable to automatically disconnect the input filter during the following conditions:

a. With loss of Rectifier/Charger input power.

b. When the critical load is below a threshold, user programmable, from 0% to 25% of UPS module rated capacity.

2.4 UNINTERRUPTIBLE POWER SUPPLY OPTIONS AND ACCESSORIES

The uninterruptible power system shall consist of the following options and accessories:

2.4.1 Battery Cabinets

The battery cabinets shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinets shall have the following features:

a. Battery Capacity Protection Time (at 25 degrees C): 29 minutes.

b. The battery cabinets shall the same depth and height as the UPS module. The battery cabinet shall be 43 inches.

c. The battery cabinets shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinets shall provide top and bottom cable entry.

d. Each battery cabinet shall feature 10 battery trays which can be individually disconnected from the battery cabinet power wiring

with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.

f. The battery cabinets shall be available in an integral configuration (line-up & match), where multiple battery cabinets shall be secure together. In this configuration the number one battery cabinet shall provide the electrical connection to secure all the battery cabinets to the UPS module with a single quick disconnect device. All power wiring and control wiring shall be provided by the manufacturer. All power wiring and control wiring shall pass through the battery cabinets. All power wiring and control wiring connections between multiple battery cabinets and the UPS module shall be secured with quick disconnect devices.

g. The battery cabinets shall be available in a remote configuration, where multiple battery cabinets stand apart from the UPS module and but shall be installed secured to each other. Power wiring and control wiring between battery cabinet shall pass through the battery cabinets. All power wiring and control wiring connections between multiple battery cabinets and the UPS module shall be secured with quick disconnect devices. All power wiring and control wiring between the number one battery cabinet and UPS module shall be provided by others.

h. The battery cabinets shall be available in a remote configuration, where multiple battery cabinets stand apart from the UPS module and shall be installed separate from each other. The power wiring and control wiring between multiple battery cabinets and the UPS module shall be provided by others.

i. The battery cabinets shall each feature a DC rated circuit breaker. The circuit breaker within an individual battery cabinet shall only provide protection to the battery string with that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.

j. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.

k. The circuit breaker in each battery cabinet shall feature a 24 VDC shunt trip.

2.4.1.1 Expected Battery Life

200 complete full load discharge cycles when operated and maintained within specifications.

2.4.1.2 Final Discharge Voltage

Full Load: 1.66 V per cell (adjustable).

No Load: 1.75 V per cell (adjustable). The UPS module shall automatically select the final discharge voltage (either 1.66 or 1.75 Volts per cell) based on the rate and length of discharge.

2.4.1.3 Nominal Float Voltage

2.25 V per cell.

2.4.1.4 Maximum Equalizing Voltage

2.40 V per cell.

2.4.2 Maintenance Bypass Panel

The Maintenance Bypass Panel (hereafter referred to as the MBP) shall provide electrical power to the critical load from the UPS module output or utility bypass and shall have the following features:

a. The MBP shall provide a make before break power transfer to the critical load between the UPS module output and utility bypass.

b. The MBP shall provide disconnect devices enclosed within galvanized steel boxing with code gauge steel trim painted ANSI 61 gray. Integral bussing shall be factory installed, tin-plated aluminum for 250 amperes.

   Three Device - This configuration shall include the UPS module wrap around (maintenance bypass) disconnect, UPS module output disconnect and UPS module bypass input disconnect devices.

c. The MBP disconnect devices shall be available as either molded case switches or molded case circuit breakers.

d. The MBP shall be 250 amps.

e. An interlock key shall be available which provides electrical isolation between the UPS module inverter output power and the utility bypass circuit while transferring power to the critical load.

f. A breaker auxiliary switch shall be available which provides includes 2NO and 2NC contacts suitable for remote signaling and indication of the circuit breakers main contact position.

g. A breaker shunt trip device shall be available which provides remote controllable tripping of circuit breakers with 24 VDC.

2.5 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

2.5.1 UPS Continuous Ratings

The UPS shall be rated at 50 kVA maximum for a load power factor range of 0.8 lagging to 0.9 leading (

The UPS shall be rated at 40 kW

2.5.2 Rectifier/Charger Input

2.5.2.1 Nominal Input Voltage

208 VAC, 3-phase, 3-wire plus ground

2.5.2.2 Operating Input Voltage Range

+10%, -15% of average nominal input voltage without battery discharge.

2.5.2.3 Operating Input Frequency Range

Operating input frequency range is within 3 Hz of the nominal input frequency:

a. For a 60 Hz UPS module, the range is 57 to 63 Hz.

b. The frequency range is adjustable to nominal $\pm$ 5 Hz, factory set.

2.5.2.4 Input Power Factor Range With Optional Input Filter

0.95 lag minimum (with optional input filter) at full load and nominal input voltage (with battery on float).

2.5.2.5 Normal Input Current Limit

The UPS module shall have the following programmable input current limit settings while operating in Normal mode:

a. Rectifier/Charger Input Current Limit: Shall be adjustable from 50% to 100% of full-load input current.

b. Battery Input Current Limit: Battery charge current limit shall be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.

2.5.2.6 On Generator Input Current Limit

The UPS module shall have the following programmable input current limit settings while operating in Normal mode on generator:

a. Rectifier/Charger Input Current Limit: Shall be adjustable from 50% to 100% of full-load input current.

b. Battery Input Current Limit: Battery charge current limit shall be adjustable from 10% to 25% of the UPS module's full load input current regardless of the actual load on the UPS module.

2.5.2.7 Input Current Total Harmonic Distortion (THD) With Optional Input Filter

10% Maximum.

2.5.2.8 Magnetizing Inrush Current

Typically 800% of the largest model's full load rectifier input current. The input isolation transformer doubles this value.

2.5.2.9 Power Walk-In

Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

2.5.3 Bypass Input

2.5.3.1 Synchronizing Bypass Voltage Range

+/-10% of average nominal input voltage.

2.5.3.2 Synchronizing Bypass Frequency Range

Synchronizing bypass frequency range is centered on the nominal frequency 60 Hz.

2.5.3.3 Magnetizing Inrush Current

Typically 800% of the largest model's full load rectifier input current.

2.5.3.4 Input Surge Withstand Capability

The UPS shall be in compliance with ANSI C62.41, Category A & B (6 kV).

2.5.4 Rectifier/Charger Output

2.5.4.1 Nominal DC Voltage

Nominal DC voltage shall be 540

2.5.4.2 Steady State Voltage Regulation

+/- 0.5%

2.5.4.3 Voltage Ripple

less than 0.5% (peak to peak)

2.5.4.4 Capacity

The Rectifier/Charger shall support a fully-loaded Inverter and recharge the battery to 95% of its full capacity within 10 times the discharge time when input current limit is set at maximum.

2.5.4.5 Low Line Operation

The Rectifier/Charger shall be capable of sharing the DC load with the Battery when the input voltage falls below the specified operating input voltage range, The On Battery indicator shall enunciate operation in this mode.

2.5.4.6 Battery Equalize

Automatic and manual means must be provided for battery equalization

2.5.4.7 DC Sensing

Redundant DC voltage sensing methods shall be incorporated for providing battery overvoltage protection.

2.5.5 UPS Output in Normal Mode

2.5.5.1 Nominal Output Voltage

208 VAC, 3-phase, 3-wire plus ground or 4-wire plus ground

2.5.5.2 Steady-State Voltage Regulation (on Inverter)

Within +/-1% average from nominal output voltage.

2.5.5.3 Transient Voltage Response

Within +/-5% from nominal voltage for a 100% load step, full load re-transfers and full load drop on battery.

2.5.5.4 Transient Voltage Recovery

25 ms to within +/-1% of steady state.

2.5.5.5 Linear Load Harmonic Distortion Capability

Output voltage THD of less than 3% into 100% linear load; 2% for a single harmonic.

2.5.5.6 Non-Linear Load Harmonic Distortion Capability

Output voltage THD of less than 5% for 100% non-linear load with a 3:1 crest factor.

2.5.5.7 Manual Output Voltage Adjustment

+/-5% from nominal.

2.5.5.8 Line synchronization Range

+/-0.5 Hz, adjustable to +/- 5 Hz.

2.5.5.9 Frequency Regulation

+/-0.005 Hz free running.

2.5.5.10 Frequency Slew Rate

1 Hz/second maximum (adjustable).

2.5.5.11 Phase Angle Control

Balanced Linear Loads: +/-1 degree from nominal 120 degrees.

Unbalanced Linear Loads: +/-3 degrees from average phase voltage for 100% load unbalance.

2.5.5.12 Phase Voltage Control

Balanced Linear Loads: +/-1% from average phase voltage.

Unbalanced Linear Loads: +/-3% for 100% load unbalance.

2.5.5.13 Overload Current Capability (with nominal line and fully charged battery)

The unit shall maintain voltage regulation for 125% for 10 minutes and 150% for 10 seconds.

2.5.5.14 Fault Clearing Current Capability

160% phase-to-phase for 10 cycles; 300% phase-to-neutral for 10 cycles.

2.5.5.15 Static Transfer Time

Make-before-break transfer completed in less than 4 ms.

2.5.5.16 Common Mode Noise Attenuation

-65 dB up to 20 kHz, -40 dB up to 100 kHz.

2.5.6 UPS Output in Bypass Mode

2.5.6.1 Nominal Output Voltage

208 VAC, 3-phase, 3-wire plus ground or 4-wire plus ground

2.5.6.2 Static Transfer Time

Make-before-break transfer completed in less than 4 ms.

2.5.6.3 Common Mode Noise Attenuation

-65 dB up to 20 kHz, -40 dB up to 100 kHz.

2.6 MECHANICAL DESIGN

2.6.1 Enclosures

The UPS module shall be housed in free-standing, double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be designed for industrial or computer room applications in accordance with the environmental requirements. The enclosures shall line up and match up in style and color for an aesthetically pleasing appearance. Each of the enclosures shall be shipped separately with joining hardware to be bolted together at the time of installation.

2.6.2 Ventilation

The UPS module shall be designed for forced air cooling. Air inlets shall be in the lower front. Air outlets shall be in the rear of the top. Twelve inches of clearance over the UPS air outlets shall be required for proper air circulation. Air filters for the UPS module shall be in commonly available sizes.

No back or side clearance or access shall be required for any enclosure. The back & side enclosure covers shall be capable of be located directly adjacent to a wall.

2.6.3 Cooling Fans

The modular design of the UPS module shall permit removal of each fan

without removal of any other assembly. Fan replacement shall be accomplished by removing no more than one fastener per fan and shall not require the removal of another subassembly.

2.6.4 Cable Entry

Standard cable entry for the UPS module shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS module for routing user input and output wiring.

2.6.5 Front Access

All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). All components with exception of the power magnetics shall be located within the front 12 inches of the UPS module enclosure for easy maintenance access. Removal and replacement of any subassembly shall not require the removal of another subassembly. Side or rear access to the UPS module shall not be required for UPS module installation, service, repair or maintenance.

2.6.6 Service Area Requirements

The UPS module, battery and options enclosures shall require no more than thirty inches (30") of front service access room, and shall not require side access for service or installation.

2.6.7 Size

The UPS module shall not exceed a depth of 31.5 inches or a height of 73.5 inches. The UPS module input voltage configurations shall not exceed a width of 34" and installation weight of 2,075 lbs.

2.7 CONTROLS AND INDICATORS

2.7.1 Micro-Controller Operated Circuitry

The UPS controls shall have the following design and operating characteristics:

Fully automatic operation of each UPS module shall be provided through the use of micro-controllers. (Digital signal processing shall eliminate variances from component tolerance or drift, and provide consistent operational responses.)

All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. All adjustments and calibrations shall be performed without the use of potentiometers. Printed circuit board replacement shall be possible without requiring calibration.

Start-up and transfers shall be automatic functions.

Multiple micro-controllers shall be used, so no single controller is in a mission critical application.

All configuration, setup and calibration information shall be stored in non-volatile memory that does not require a control battery for data storage.

Emergency transfers to Bypass due to UPS module failure, shall be independent of the control logic controlling the Rectifier/Charger, Inverter and Monitor panel. Emergency transfer circuitry shall contain all the necessary circuitry to perform an emergency transfer without any other functioning logic.

Monitoring and communications logic shall be independent of the Rectifier/Charger and Inverter control logic. Circuitry and firmware required for monitoring and communications logic shall be functionally isolated from the Bypass, Rectifier/Charger and Inverter controls. Monitoring firmware shall be field upgradeable.

The UPS module shall be programmable to optionally provide automatic restart capability following loss of utility and a complete battery discharge. When utility power returns, the UPS module shall automatically energize the output terminals and subsequently transfer to Normal mode.

2.7.2 Monitor Panel Indicators

The UPS module shall be equipped with a monitor panel providing the following monitoring functions and indicators (each alarm and notice condition shall be accompanied with an audible alarm):

2.7.2.1 NORMAL

This symbol shall be lit when the UPS module is operating in Normal mode.

2.7.2.2 BATTERY

This symbol shall be lit when the UPS module is operating in Battery mode. The Normal indicator also remains lit.

2.7.2.3 BYPASS

This symbol shall be lit when the UPS module is operating in Bypass mode. The critical load is supported by the Bypass source. The Normal indicator shall not be lit when the UPS module is in Bypass mode.

2.7.2.4 NOTICE

This symbol shall be lit when the UPS module needs attention. Some notices may be accompanied by an audible horn. Notices shall include:

Bypass not available
Battery undervoltage

2.7.2.5 ALARM

This symbol shall be lit when a situation requires immediate attention. All alarms shall be accompanied by an audible alarm. Alarms shall include:

a. Over temperature
b. Output overload
c. Inverter failure
d. Rectifier/Charger failure
e. Shutdown imminent (Low battery in Emergency mode.)

2.7.2.6 STANDBY

This symbol shall be lit when electricity is present in the rectifier and Inverter while the Normal indicator is not lit. During normal startup this indicator shall remain lit until the UPS module transfers to Normal mode, at which time the Normal indicator shall light. During normal shutdown the Standby indicator shall remain lit until all energy in the UPS module is dissipated and shutdown is complete.

2.7.3 Monitor Panel Controls

The UPS module shall be equipped with a monitor panel providing the following control functions:

2.7.3.1 Menu and Cursor Controls

Selects, displays and scrolls data on the LCD.

2.7.3.2 Load Off

Shuts down the UPS module, de-energizes the critical load and opens the UPS module's breakers and contactors.

2.7.3.3 Horn Silence

Silences the current audible alarm(s). The Horn shall sound again if new alarms occur.

2.7.3.4 Screen Adjust

Controls the liquid crystal display contrast.

2.7.4 Monitor Panel Liquid Crystal Display (LCD)

The UPS module shall feature a liquid crystal display measuring 6" by 7.5" with 30 lines of information, 80 characters wide. The display shall feature an autoblanking feature. Graphical user screens shall be provided on the Monitor panel LCD to display the UPS module's operating parameters. The monitor panel pushbuttons shall be used to access information in these screens. Information in the meter screen and alarm history screen shall be available to a remote terminal or printer through the RS-232 (EIA/TIA-232) communication port. The screens shall include:

2.7.4.1 Common Information

The following information shall be presented on the LCD panel at all times:

a. UPS Module Identification: A user programmable UPS module identification of up to 45 characters.

b. UPS module status.

c. Highest priority active alarm.

d. Highest priority active notice.

e. Real time clock, featuring time and date indications, which is programmable from the monitor panel.

f. Real-time battery time available (in the event a utility outage occurs) for the current critical load.

2.7.4.2 UPS Module Meter Screen

Real-time digital metering of:

a. Rectifier/Charger inputs: voltage (per phase, RMS), current (per phase), frequency, kW, kVA, power factor.

b. UPS module outputs: voltage (per phase, RMS), current (per phase plus neutral), frequency, kW, kVA, power factor. Output voltage and current sensing shall independent of the Inverter controls.

c. Bypass inputs: voltage (per phase, RMS).

d. DC link voltage.

e. Battery charge and discharge current.

2.7.4.3 Output Current Screen

Bar graph display of the percent output current of each phase.

2.7.4.4 Event History Screen

Shall display up to 400 of the most recent events by date and time. Time shall be displayed in tenths of seconds (0.1 sec) and recorded in thousandths of seconds (0.001 sec). The screen shall define and display events as either alarms, notices, commands or status. A brief description shall be provided for each event recorded on this screen. When a system event occurs, a message shall be added to the Event History Log. The message shall optionally appear on the Monitor Panel of the UPS. The Event History Log shall support the following system event messages, whether or not they were displayed on the Monitor Panel.

INVERTER MESSAGES - ALARMS

Inverter DC Over Voltage
Inverter AC Over Voltage
Inverter AC Under Voltage
Inverter Over Frequency
Inverter Under Frequency
Over Temperature Shutdown
100% Overload Shutdown
125% Overload Shutdown
Battery Contactor Failure
Bypass Contactor Failure
Bypass Control Failure
Inverter Contactor Failure
Inverter Failure
Load Off
Inverter Contactor Open
Bypass Contactor Failure

INVERTER MESSAGES - NOTICES

Bypass AC Over Voltage
Bypass AC Under Voltage

Bypass Over Frequency
Bypass Under Frequency
Battery DC Under Voltage
Battery Not Charged
Bypass Is Not Available
Input Breaker Open
Inverter Logic Power Failure
Phase A Current Limit
Phase B Current Limit
Phase C Current Limit
Load Transferred to Bypass

INVERTER MESSAGES - COMMANDS

Bypass Mode
Keyswitch On
Inverter Commanded On

INVERTER STATUS MESSAGES

Inverter On
Battery Contactor Closed
Total Battery Discharge
Bypass Contactor Closed
Input Breaker Closed
Inverter Contactor Closed
Inverter Shutdown
Inverter Normal
Load Transferred to Bypass
Auto Mode

RECTIFIER MESSAGES - ALARMS

Rectifier DC Over Voltage
Rectifier DC Under Voltage
Rectifier Over Temperature
Rectifier Over Temperature Warning
Rectifier Temperature Sensor Failure
Rectifier Failure
Rectifier Alarm

RETIFIER MESSAGES - NOTICES

Input AC Over Voltage
Input AC Under Voltage
Input AC Over Frequency
Input AC Under Frequency
Rectifier Logic Power Supply OV
Rectifier Logic Power Supply UV
Rectifier DC Too Low
Input Voltage Transient
Rectifier Logic Power Failure
Battery Current Limit
DC Too High

RECTIFIER MESSAGES - COMMANDS

Rectifier Commanded On

RECTIFIER STATUS MESSAGES

Rectifier On
Rectifier Shutdown

MONITOR PANEL ALARMS

Load over 100%
Overload 100%
Overload 125%
Power Supply Failure
Fan Failure

MONITOR PANEL NOTICES

Output AC Over Voltage
Output AC Under Voltage
Output Over Frequency
Output Under Frequency
Phase AC Over Voltage
Phase AC Under Voltage
Phase Over Frequency
Phase Under Frequency
Power Fail
Power Off Switch
Building Alarm 1
Building Alarm 2
Building Alarm 3
Building Alarm 4
Building Alarm 5
Building Alarm 6
Rectifier Network Down
Inverter Network Down
Monitor Network Down

2.7.4.5 Active Events Screen

Shall automatically display a list of all active alarms and notices.

2.7.4.6 Statistics Screen

This screen shall display the following:

a. Time on battery: A record shall display the duration and frequency of utility outages in the life of the batteries and in the current month.

b. Building alarms: A record shall display the frequency of each building alarm enunciation in the life of the UPS module and in the current month.

c. Operational History: A record shall display the total amount of time the UPS module has been in the each of the following modes of operation: Normal, Bypass and Battery. A record shall display the total amount of time the UPS module has been on generator.

d. Availability: The observed availability of the Normal mode shall be displayed. In addition, the availability of the Bypass supply as a backup source shall be displayed.

e. Startup Date: The date the UPS module was initially energized shall be displayed.

2.7.4.7 UPS Module Mimic Screen

A graphic display of the UPS module operational mode and power flow through the UPS module to the critical load shall be displayed in real-time. The operational status of the Inverter, Rectifier/Charger, Bypass and Battery is also indicated. Circuit breaker and contactor states shall be indicated.

2.7.4.8 Setup Screen

Shall permit setting time and date for the UPS module clock with controls on the Monitor Panel. Shall permit configuration of the RS232 and RS485 communications ports, with controls on the Monitor Panel, for the following modes of operation:

a. Terminal Mode: UPS module events shall be logged immediately as they occur.

b. Calibration Mode: Shall be used by service personnel for UPS module diagnostics.

c. UPS Module Configuration Mode: Shall allow setup and configuration of user level functions like battery test and building alarms. Shall allow the six building alarms to be customized with a description of up to 30 characters for display locally on the monitor panel screens and remotely. Shall allow the six building alarms to be programmed to initiate UPS module commands upon contact closure.

d. Computer Mode: Shall allow the user to interface with the UPS module in Binary Computer Mode.

e. Remote Monitor Mode: The RS485 port shall be configured to interface with a Remote Monitor Panel, Supervisory Contact Module or Relay Interface Module.

2.7.4.9 Control Panel

The UPS module shall be equipped with a control panel providing UPS module control functions. (A key shall be required to turn on the UPS module.) The following controls shall be provided on the control panel:

a. The Keyswitch shall initiate the energize sequence to place the UPS module in either Normal mode or Bypass mode, as defined by the Mode switch position.

b. The Mode switch shall control the manual transfer of the UPS module to and from Bypass mode.

c. The Battery switch shall enable or disable the internal battery contactor closure.

d. A circuit breaker shall enable operation of the rectifier.

e. A Load Off Reset switch shall reset the UPS module, following a Load Off command.

2.7.4.10 Communication Panel

The UPS module shall be equipped with a communication panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:

a. Alarm and Notice Contacts: Dry contacts for summary alarms and notices shall be provided for external use.

   Alarm: Indicates the UPS module is experiencing an Alarm condition.

   Notices: Indicates the UPS module is experiencing a Notice condition.

b. RS-232 (EIA/TIA-232) and RS-485 Communication Interface: Circuitry shall be provided for one RS-232 (EIA/TIA-232) and one RS-485 communication port. These ports may be used with simple terminals to gain remote access to all unit operation information.

c. Remote Monitor Panel Connection: Circuitry shall be provided for connection of up to two accessory remote monitor panels, relay interface modules or supervisory contact module.

d. Building Alarms: Six inputs shall be provided for monitoring the status of external dry contacts. One input shall be dedicated to monitoring an external battery disconnect, and one shall be dedicated to monitoring an auxiliary generator and initiating reduced input current limit. The remaining four inputs shall be user selected (smoke, temperature, water, etc.) Building alarms shall be set up through the UPS module configuration mode function of the RS-232 (EIA/TIA-232) port. The building alarms shall also provide the following capabilities:

   Building alarms shall allow the user to customize the building alarm message (up to 30 characters max.) which appears locally on the Monitor Panel or remotely through the communication ports.

   Building alarms shall be programmable to initiate a transfer of the UPS module from Normal Mode to Bypass Mode upon contact closure.

   Building alarms shall be programmable to initiate a transfer of the UPS module from Bypass Mode to Normal Mode upon contact closure.

2.8 UPS MODULE PROTECTION

Rectifier/Charger protection shall be provided by thermal-magnetic or RMS current sensing molded-case circuit breakers and transient suppression circuitry.

Bypass protection shall be provided through individual fusing of each phase.

The static switch shall feature a thermal switch which will open the backfeed contactor in the event the static switch temperature exceeds normal operating parameters

Battery protection shall be provided by individual fusing or thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.

Output protection shall be provided by electronic current limit circuitry and fuses in the Inverter circuit.

Input wiring to the Rectifier/Charger input and Bypass input shall be monitored for proper sequencing. If wiring is installed out of sequence, the

UPS module shall detect and enunciate this condition (on the Monitor Panel) when power is supplied to the inputs. The UPS module shall not allow operation in Normal mode until the wiring error is corrected.

Inverter circuitry shall be provided which automatically inhibits the Inverter IGBT switching currents should they exceed normal operating parameters.

The UPS module shall remain in Normal mode during a failure condition where the Bypass backfeed protection fails. Manual transfers between Normal mode and Bypass mode shall be possible with this failure condition

The UPS module shall remain in Normal mode during a failure condition where one or more SCRs in the static switch shorts. Manual transfers between Normal mode and Bypass mode shall be possible with this failure condition

To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

The following procedures and tests shall be performed by Field Service personnel during the UPS startup:

3.2.1 Visual Inspection

Visually inspect all equipment for signs of damage or foreign materials.

Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.

3.2.2 Mechanical Inspection

Check all the power connections for tightness.

Check all the control wiring terminations and plugs for tightness or proper seating.

3.2.3 Electrical Precheck

Check the DC bus for a possible short circuit.

Check input and Bypass power for proper voltages and phase rotation.

Check all lamp test functions.

3.2.4 Initial UPS Startup

Verify that all the alarms are in a "go" condition.

Energize the UPS module and verify the proper DC, walkup, and AC phase on.

Check the DC link holding voltage, AC output voltages, and output wave forms.

Check the final DC link voltage and Inverter AC output. Adjust if required.

Check for the proper synchronization.

Check for the voltage difference between the Inverter output and the Bypass source.

3.2.5 Operational Training

Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.3 MANUFACTURER'S FIELD SERVICE

3.3.1 Field Engineering Support

The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours 80% of the time. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.

3.3.2 Spare Parts Support

Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.

3.3.3 Maintenance Contracts

A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest engineering levels as they are developed.

3.3.4 Product Enhancement Program

The UPS manufacturer shall make available feature upgrade service offerings

to all users as they are developed. These products shall be proposed as a field-installable, optional kit.

-- End of Section --